

**IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION**

WSOU INVESTMENTS, LLC d/b/a
BRAZOS LICENSING AND
DEVELOPMENT,

Plaintiff,

V.

ZTE CORPORATION, ZTE (USA)
INC., AND ZTE (TX), INC.

Defendants.

[illegible]

CIVIL ACTION NO. 6:20-cv-228

JURY TRIAL DEMANDED

ORIGINAL COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff WSOU Investments, LLC d/b/a Brazos Licensing and Development (“Brazos” or “Plaintiff”), by and through its attorneys, files this Complaint for Patent Infringement against Defendants ZTE Corporation, ZTE (USA), Inc. and ZTE (TX), Inc. (collectively “ZTE” or “Defendants”) and alleges:

NATURE OF THE ACTION

1. This is a civil action for patent infringement arising under the Patent Laws of the United States, 35 U.S.C. §§ 1, et seq., including §§ 271, 281, 284, and 285.

THE PARTIES

2. Brazos is a limited liability corporation organized and existing under the laws of Delaware, with its principal place of business at 605 Austin Ave, Ste 6, Waco, TX 76701.

3. On information and belief, Defendant Zhongxing Telecommunications Equipment (abbreviated as “ZTE”) Corporation is a Chinese corporation that does business in Texas, directly or through intermediaries, with a principal place of business at ZTE Plaza, Keji Road South, Hi-Tech Industrial Park, Nanshan District, Shenzhen China.

4. On information and belief, Defendant ZTE (USA) Inc. is a New Jersey corporation that does business in Texas, directly or through intermediaries, with a principal place of business in business in Richardson, Texas.

5. On information and belief, Defendant ZTE (TX) Inc. is a Texas corporation that does business in Texas, directly or through intermediaries, with a principal place of business in business in Austin, Texas.

6. All of the Defendants operate under and identify with the trade name “ZTE.” Each of the Defendants may be referred to individually as a “ZTE Defendant” and, collectively, Defendants may be referred to below as “ZTE” or as the “ZTE Defendants.”

JURISDICTION AND VENUE

7. This is an action for patent infringement which arises under the Patent Laws of the United States, in particular, 35 U.S.C. §§271, 281, 284, and 285.

8. This Court has jurisdiction over the subject matter of this action under 28 U.S.C. §§ 1331 and 1338(a).

9. This Court has specific and general personal jurisdiction over each ZTE Defendant pursuant to due process and/or the Texas Long Arm Statute, because each ZTE Defendant has committed acts giving rise to this action within Texas and within this judicial district. The Court’s exercise of jurisdiction over each ZTE Defendant would not offend traditional notions of fair play and substantial justice because ZTE has established minimum contacts with the forum. For example, on information and belief, ZTE Defendants have committed acts of infringement in this judicial district, by among other things, selling and offering for sale products that infringe the asserted patent, directly or through intermediaries, as alleged herein.

10. Venue in the Western District of Texas is proper pursuant to 28 U.S.C. §§1391 and/or 1400(b). The ZTE Defendants have committed acts of infringement and have places of businesses in this District and/or are foreign entities for purpose of §1391. As non-limiting examples, ZTE (TX) has maintained a place of business at 7000 N MO-PAC EXPRESSWAY 200 AUSTIN, TX 7873; and, ZTE (USA) has maintained a place of business at 6500 River Place Blvd., Austin, TX 78730. ZTE Corporation also describes a “research-and-development center in Austin, Texas.”¹

COUNT ONE - INFRINGEMENT OF
U.S. PATENT NO. 8,179,960

11. Brazos re-alleges and incorporates by reference the preceding paragraphs of this Complaint.

12. On May 15, 2012, the United States Patent and Trademark Office duly and legally issued U.S. Patent No. 8,179,960 (“the ’960 Patent”), entitled “METHOD AND APPARATUS FOR PERFORMING VIDEO CODING AND DECODING WITH USE OF VIRTUAL REFERENCE DATA.” A true and correct copy of the ’960 Patent is attached as Exhibit A to this Complaint.

13. Brazos is the owner of all rights, title, and interest in and to the ’960 Patent, including the right to assert all causes of action arising under the ’960 Patent and the right to any remedies for the infringement of the ’960 Patent.

14. ZTE makes, uses, sells, offers for sale, imports, and/or distributes, in the United States, video display products, including phones (collectively, the “Accused Products”).

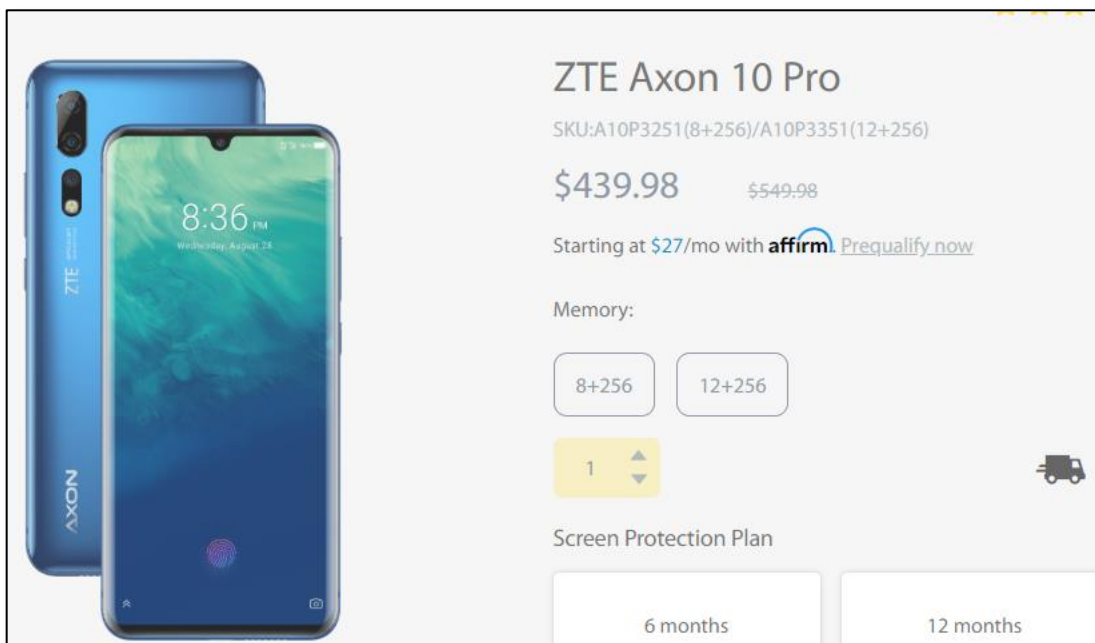
¹ https://res-www.zte.com.cn/mediare/magazine/publication/tech_en/pdf/201009.pdf

15. The Accused Products include Axon 10 Pro phones.

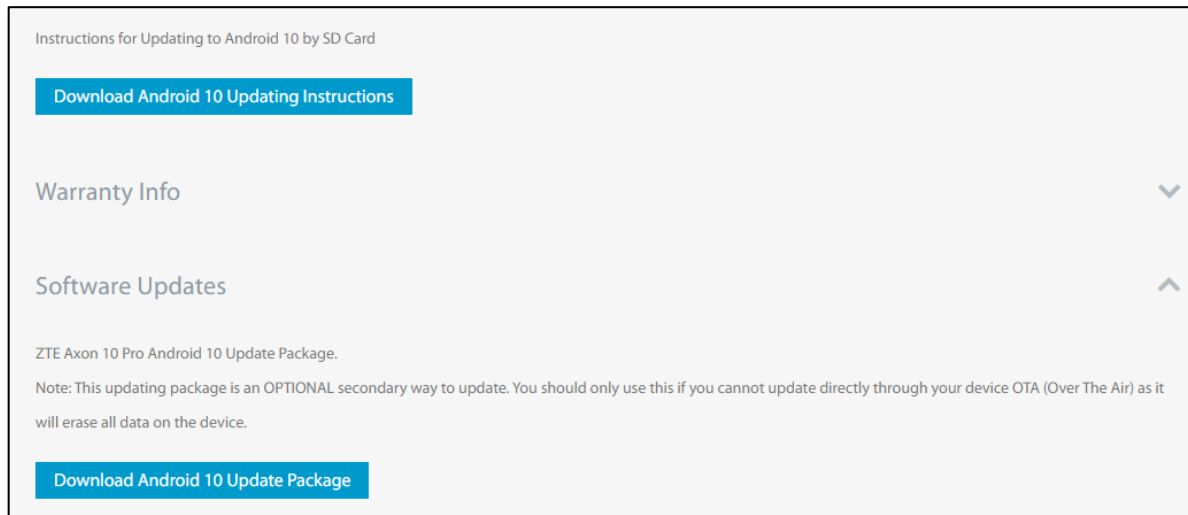


<https://www.zteusa.com/products/all-phones/axon-10-pro.html>.

16. The Accused Products run the Android 10 operating system. In addition to “over the air” updates provided by ZTE, the ZTE (USA) website provides a software package and instructions for users to upgrade the existing operating system of the mobile devices to Android 10.

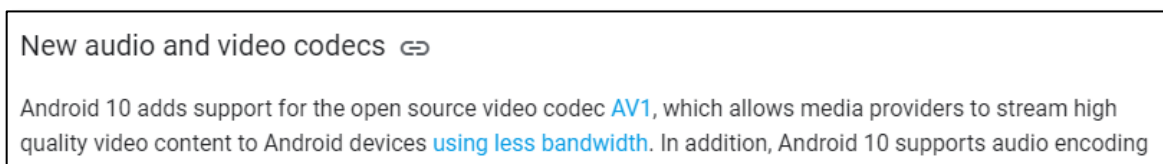


. . .



<https://www.zteusa.com/axon-10-pro>.

17. Codecs are used to generate an encoded video signal from an original video signal. Multiple video providers and browsers use codecs for streaming videos for display on mobile devices. The Android 10 operating system supports multiple videos and audio codecs, including AV1. AV1 is a video codec developed by Alliance for Open Media (AOM). It is related to the V9 and V8 codecs.



<https://developer.android.com/about/versions/10/highlights>.

VP9 Overview

VP9 is a next-generation video compression format developed by the [WebM Project](#). VP9 supports the full range of web and mobile use cases from low bitrate compression to high-quality ultra-HD, with additional support for 10/12-bit encoding and HDR.

VP9 can reduce video bit rates by as much as 50% compared with other known codecs. It is supported for adaptive streaming and is used by [YouTube](#) as well as other leading web video providers.

VP9 decoding is supported on over 2 billion end points including Chrome, Opera, Edge, Firefox and Android devices, as well as millions of smart TVs.

The logo for VP9, with 'VP' in dark grey and '9' in a vibrant green.

<https://developers.google.com/media/vp9>

What is the AV1 Codec?

AV1 is an open, royalty-free, next-generation video coding format from the Alliance of Open Media Video. It is designed to replace Google's VP9 and compete with H.265/HEVC. AV1 is targeting an expected improvement of about 30% over VP9/HEVC with only reasonable increases in encoding and playback complexity.

<https://bitmovin.com/av1/>.

18. An original video signal contains several frames, and the resolution of the video signal specifies the width and height of these frames. The frame rate of a video signal informs about the number of images displayed per second.

Resolution

Every video has a frame size (indicating the pixel width and height). The following FFmpeg command-line parameter can be used to control the output video frame size for VP9 encoding:

FFmpeg	Frame width and height
<code>-vf scale=<width>x<height></code>	

For example, the following FFmpeg command will output a 640x480 VP9 WebM video.

```
ffmpeg -i tears_of_steel_1080p.webm -vf scale=640x480 \
-c:v libvpx-vp9 -c:a libopus output.webm
```

Smaller resolutions are lower quality, but larger resolutions require more bandwidth, more processing power to decode, and may not be supported on older devices. For VP9, 640x480 is considered a safe resolution for a broad range of mobile and web devices.

★ **Note:** Every video also has a frame rate (the number of images displayed per second). By default, FFmpeg matches the output video frame rate to the input.

<https://developers.google.com/media/vp9/the-basics>.

19. A video codec reduces the size of an original video stream by encoding it to compress it.

What Is a Codec?

To shrink a video into a more manageable size, content distributors use a video compression technology called a codec. Codecs allow us to tightly compress a bulky video for delivery and storage.

Literally 'coder-decoder' or 'compressor-decompressor,' codecs apply algorithms to the video and create a facsimile of it. The video is shrunk down for storage and transmission, and later decompressed for viewing.

Streaming employs both audio and video codecs. H.264, also known as AVC, is the most common video codec. AAC is the most common audio codec.

<https://www.wowza.com/blog/video-codecs-encoding>.

20. AV1 increases the number of reference frames to be used (e.g., from 3 in the case of VP9 to 7). The 'ALTREF', 'GOLDEN' and 'LAST' frames being the frames already present in the VP9 codec, AV1 codec generates two additional frames each from near past frames and

future frames. The 'ALTREF2' frame acts as an intermediate frame between 'GOLDEN' and 'ALTREF'. The ALTREF and ALTREF2 contain the virtual reference data that is to be only used for the encoding purpose and does not contain any data that is to be displayed in the subsequent display of the video stream. The ALTREF frame can be a no-show reference obtained through temporal filtering.

1) Extended Reference Frames: AV1 extends the number of references for each frame from 3 to 7. In addition to VP9's LAST(nearest past) frame, GOLDEN(distant past) frame and ALTREF(temporal filtered future) frame, we add two near past frames (LAST2 and LAST3) and two future frames (BWDREF and ALTREF2)[7]. Fig.2 demonstrates the multi-layer structure of a golden-frame group, in which an adaptive number of frames share the same GOLDEN and ALTREF frames. BWDREF is a look-ahead frame directly coded without applying temporal filtering, thus more applicable as a backward reference in a relatively shorter distance. ALTREF2 serves as an intermediate filtered future reference between GOLDEN and ALTREF. All the new references can be picked by a single prediction mode or be combined into a pair to form a compound mode. AV1 provides an abundant set of reference frame pairs, providing both bi-directional compound prediction and uni-directional compound prediction, thus can encode a variety of videos with dynamic temporal correlation characteristics in a more adaptive and optimal way.

https://jmvalin.ca/papers/AV1_tools.pdf (Page 2).

The use of extended ALTREF_FRAMES is proposed, and multiple ALTREF_FRAME candidates are selected and widely spaced within one GF group. ALTREF_FRAME is a constructed, no-show reference obtained through temporal filtering of a look-ahead frame. In the multi-layer structure, one reference frame may serve different roles for the encoding of different frames through the virtual index manipulation. The experimental results have been collected over several video test sets of various resolutions and characteristics both texture- and motion-wise, which demonstrate that the proposed approach achieves a consistent coding gain compared to the AV1 baseline. For instance, using PSNR as the distortion metric, an average bitrate saving of 5.57+% in BDRate is obtained for the CIF-level resolution set, some of which has a gain of up to 13+%, and 4.47% on average for the VGA-level resolution set, some of which up to 18+%.

<https://scl.ece.ucsb.edu/sites/default/files/publications/08416609.pdf> (Page 1).

21. VP8 utilizes three types of reference frames for inter prediction, namely: last frame, golden frame, and the alternate reference frame.

4. REFERENCE FRAMES

VP8 uses three types of reference frames for inter prediction: the “last frame”, a “golden frame” (one frame worth of decompressed data from the arbitrarily distant past) and an “alternate reference frame.” Overall, this design has a much smaller memory footprint on both encoder and decoder than designs with many more reference frames.

<https://static.googleusercontent.com/media/research.google.com/en/us/pubs/archive/37073.pdf>
(Page 2).

22. An Alternate Reference Frame can be generated by using multiple frames or different blocks from different video frames. Since the reference frame is created by a combination of several frames, it does not represent any portion of any individual frame.

Unlike other types of reference frames used in video compression, which are displayed to the user by the decoder, the VP8 alternate reference frame is decoded normally but is never shown to the user. It is used solely as a reference to improve inter prediction for other coded frames. Because alternate reference frames are not displayed, VP8 encoders can use them to transmit any data that are helpful to compression. For example, a VP8 encoder can construct one alternate reference frame from multiple source frames, or it can create an alternate reference frame using different macroblocks from hundreds of different video frames. The current VP8 implementation enables two different types of usage for the alternate reference frame: noise-reduced prediction and past/future directional prediction.

<http://blog.webmproject.org/2010/05/inside-webm-technology-vp8-alternate.html>.

23. AV1 provides ALTREF2 frames in addition to VP9’s ALTREF (or alternate reference frame). ALTREF frames are temporal filtered future type reference frames. ALTREF2 is an intermediate filtered future reference frame between GOLDEN and ALTREF frames. This shows that ALTREF2 does not represent any individual frame but comprises through temporal filtering and has a format between GOLDEN and ALTREF frames. In this manner, AV1 generates ALTREF and ALTREF2 frames, which are then utilized for the encoding of the video stream.

6.10.24. Ref frames semantics

comp_mode specifies whether single or compound prediction is used:

comp_mode	Name of comp_mode
0	SINGLE_REFERENCE

comp_mode	Name of comp_mode
1	COMPOUND_REFERENCE

SINGLE_REFERENCE indicates that the inter block uses only a single reference frame to generate motion compensated prediction.

COMPOUND_REFERENCE indicates that the inter block uses compound mode.

There are two reference frame groups:

- Group 1: LAST_FRAME, LAST2_FRAME, LAST3_FRAME, and GOLDEN_FRAME.
- Group 2: BWDREF_FRAME, ALTREF2_FRAME, and ALTREF_FRAME.

<https://aomediacodec.github.io/av1-spec/av1-spec.pdf> (Page 181-182)

RefFrame[0] specifies which frame is used to compute the predicted samples for this block:

RefFrame[0]	Name of ref_frame
0	INTRA_FRAME

RefFrame[0]	Name of ref_frame
1	LAST_FRAME
2	LAST2_FRAME
3	LAST3_FRAME
4	GOLDEN_FRAME
5	BWDREF_FRAME
6	ALTREF2_FRAME
7	ALTREF_FRAME

<https://aomediacodec.github.io/av1-spec/av1-spec.pdf> (Page 182-183).

24. AV1 performs the encoding of all the reference frames in order to efficiently encode the frames that are to be displayed utilizing already encoded reference frames. AV1 can use flags associated with the frames being updated.

```
// Update frame_flags to tell the encoder's caller what sort of frame was
// encoded.
static void update_frame_flags(AV1_COMP *cpi, unsigned int *frame_flags) {
    if (encode_show_existing_frame(&cpi->common)) {
        *frame_flags &= ~FRAMEFLAGS_GOLDEN;
        *frame_flags &= ~FRAMEFLAGS_BWDREF;
        *frame_flags &= ~FRAMEFLAGS_ALTREF;
        *frame_flags &= ~FRAMEFLAGS_KEY;
        return;
    }
}
```

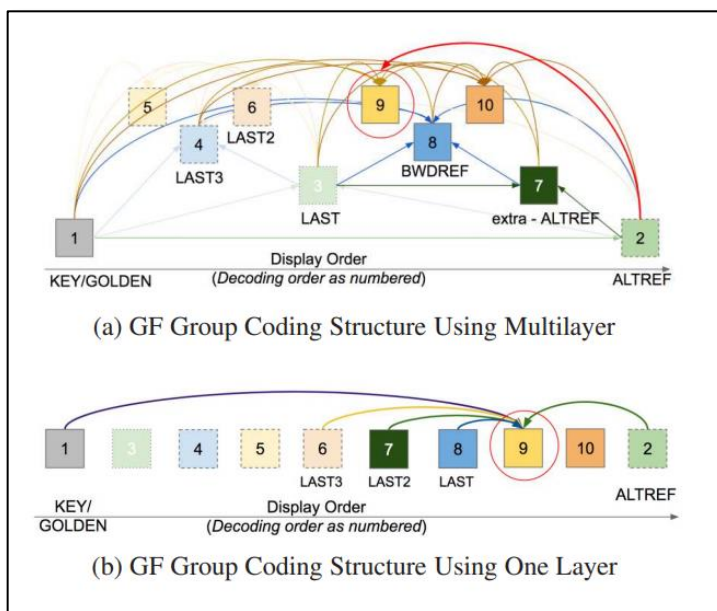
https://aomedia.googlesource.com/aom/+/master/av1/encoder/encode_strategy.c.

25. The generated Alternate Reference Frame is encoded and incorporated with the encoded video signal.

In CQ mode the encoder will try to encode normal frames (all frames apart from key frames, golden frames and alternative reference frames) at a quantizer / quality level of `--cq-level`, provided that this does not cause the bitrate to rise above the target maximum value. Key frames, golden frames and alt ref frames may be coded at a lower "q" value, but the minimum is still linked to the user-selected value, and in all cases `--min-q` and `--max-q` are treated as hard limits. In practice this means that easy clips may undershoot the target maximum bitrate, because they are constrained by the CQ level, but harder clips will be bounded by the target maximum data rate and will increasingly revert to standard VBR behavior.

<https://www.webmproject.org/docs/encoder-parameters/>

26. Moreover, the reference frames are encoded and sent with the encoded video signals and used in decoding.



<https://arxiv.org/pdf/1803.04061.pdf> (Page 2).

VP8/VP9 Alternate Reference Frames

When enabled, the VP8 and VP9 encoders will at their discretion inject a new frame -- an alternate reference (AR) frame -- into the output, prior to the frame that depends on it. There will be at MOST 1 frame added between I/P-frames. The dependent frame (D) will **always** be a P-frame. The AR will be marked with the invisible flag by the codec SDK. This frame MUST be decoded before D, but will produce no output on its own.

The encoder will currently set the AR's timestamp as close as possible to the previous frame while attempting to provide a timestamp that is strictly increasing. In cases where the time base given to the encoder at configure time is not granular enough to allow for this, the AR will share the same timestamp as D, but SHOULD be treated as having no duration.

Ideally the AR's timestamp should be as close as possible to frame D-1 to allow the decoder as much time as possible to decode AR before needing to display D.

<https://www.webmproject.org/docs/container/>.

27. AV1 incorporates the reference frames in the encoded video signal along with the marking of the type of reference frames. The type of reference frame is in itself an indication of whether the frame will be displayed in the output or not. AV1 allows the ALTREF frames to be utilized internally only and thus does not allow for them to be part of

the output.

```
int global_motion_search_done;
int internal_altref_allowed;
// A flag to indicate if intrabc is ever used in current frame.
int intrabc_used;
int dv_cost[2][MV_VALS];
// TODO(huisu@google.com): we can update dv_joint_cost per SB.
```

<https://aomedia.googlesource.com/aom/+/master/av1/encoder/encoder.h/>.

28. The 'ALTREF' frames are utilized for the encoding of other frames but are not to be displayed in the output of the video signal

The use of extended ALTREF_FRAMES is proposed, and multiple ALTREF_FRAME candidates are selected and widely spaced within one GF group. ALTREF_FRAME is a constructed, no-show reference obtained through temporal filtering of a look-ahead frame. In the multi-layer structure, one reference frame may serve different roles for the encoding of different frames through the virtual index manipulation. The experimental results have been collected over several video test sets of various resolutions and characteristics both texture- and motion-wise, which demonstrate that the proposed approach achieves a consistent coding gain compared to the AV1 baseline. For instance, using PSNR as the distortion metric, an average bitrate saving of 5.57+% in BDRate is obtained for the CIF-level resolution set, some of which has a gain of up to 13+%, and 4.47% on average for the VGA-level resolution set, some of which up to 18+%.

<https://scl.ece.ucsb.edu/sites/default/files/publications/08416609.pdf> (Page 1).

29. The encoded video signal contains an indication of the alternate reference frame is included. The alternate reference frame is marked with an invisible flag, which informs the decoder that this frame does not represent any part of the individual frame to be displayed in the video display.

VP8/VP9 Alternate Reference Frames

When enabled, the VP8 and VP9 encoders will at their discretion inject a new frame -- an alternate reference (AR) frame -- into the output, prior to the frame that depends on it. There will be at MOST 1 frame added between I/P-frames. The dependent frame (D) will **always** be a P-frame. The AR will be marked with the invisible flag by the codec SDK. This frame MUST be decoded before D, but will produce no output on its own.

The encoder will currently set the AR's timestamp as close as possible to the previous frame while attempting to provide a timestamp that is strictly increasing. In cases where the time base given to the encoder at configure time is not granular enough to allow for this, the AR will share the same timestamp as D, but SHOULD be treated as having no duration.

Ideally the AR's timestamp should be as close as possible to frame D-1 to allow the decoder as much time as possible to decode AR before needing to display D.

<https://www.webmproject.org/docs/container/>.

30. A processor encodes frames of the original video signal by utilizing AV1 reference frames at various bit rates. AV1 makes use of the extended number of reference frames to encode the original video stream efficiently. It includes both uni-directional (single) and bi-directional (compound) predictions.

1) Extended Reference Frames: AV1 extends the number of references for each frame from 3 to 7. In addition to VP9's LAST(nearest past) frame, GOLDEN(distant past) frame and ALTREF(temporal filtered future) frame, we add two near past frames (LAST2 and LAST3) and two future frames (BWDREF and ALTREF2)[7]. Fig.2 demonstrates the multi-layer structure of a golden-frame group, in which an adaptive number of frames share the same GOLDEN and ALTREF frames. BWDREF is a look-ahead frame directly coded without applying temporal filtering, thus more applicable as a backward reference in a relatively shorter distance. ALTREF2 serves as an intermediate filtered future reference between GOLDEN and ALTREF. All the new references can be picked by a single prediction mode or be combined into a pair to form a compound mode. AV1 provides an abundant set of reference frame pairs, providing both bi-directional compound prediction and uni-directional compound prediction, thus can encode a variety of videos with dynamic temporal correlation characteristics in a more adaptive and optimal way.

https://jmvalin.ca/papers/AV1_tools.pdf (Page 2).

Encode 8-bit AV1

```
aomenc -v -w 1920 -h 1080 --cpu-used=0 --target-bitrate=1500 --threads=16 --profile=0 --aq-mode=0 --lag-in-frames=25 --auto-alt-ref=1 -o av1-8bit.webm 8bit.y4m
```

Encode 10-bit AV1

```
aomenc -v -w 1920 -h 1080 --cpu-used=0 --target-bitrate=1500 --threads=16 --profile=0 --aq-mode=0 --lag-in-frames=25 --auto-alt-ref=1 -o av1-10bit.webm 10bit.y4m
```

Encode 12-bit AV1

```
aomenc -v -w 1920 -h 1080 --cpu-used=0 --target-bitrate=1500 --threads=16 --profile=0 --aq-mode=0 --lag-in-frames=25 --auto-alt-ref=1 -o av1-12bit.webm 12bit.y4m
```

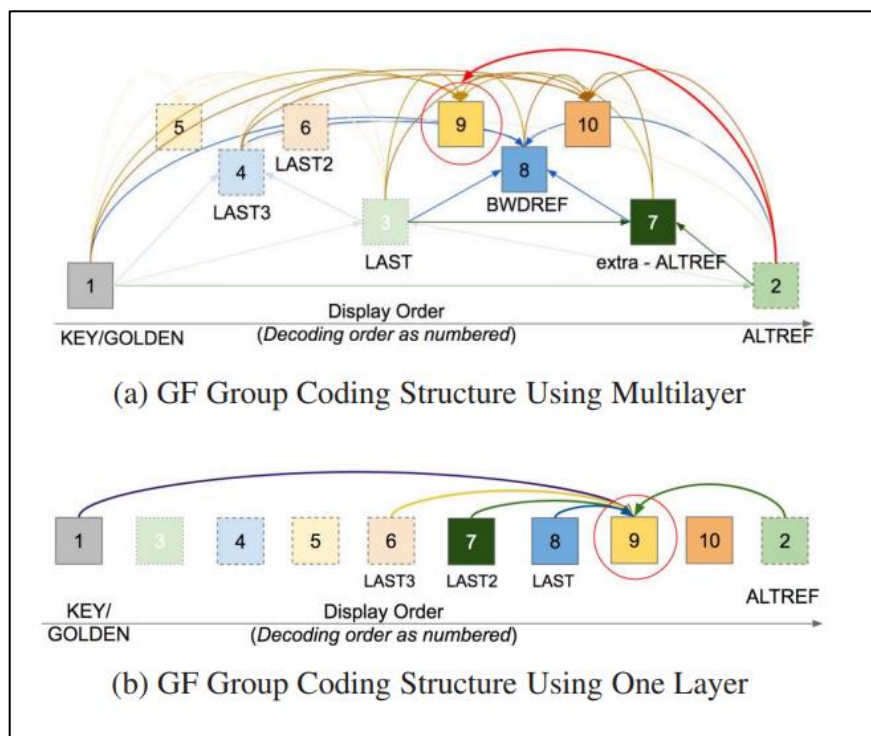
<https://nwgat.ninja/tag/av1/> (Page 1).

31. Alternate reference frames are utilized for encoding the frames that are to be displayed in the video stream. VP8 and subsequent related codecs, including AV1, achieve this through intelligent use of golden reference frames along with alternate reference frames.

VP8's ability to achieve high compression efficiency. The VP8 format, however, supports intelligent use of the golden reference and the alternate reference frames together to compensate for this. The VP8 encoder can choose to transmit an alternate reference frame assembled with content from many "future" frames using sophisticated filtering. Encoding of subsequent frames can then make use of information from the past (last frame and golden frame) and from the future (alternate reference frame). Effectively, this helps the encoder to achieve compression efficiency without requiring frame reordering in the decoder.

<https://static.googleusercontent.com/media/research.google.com/en/us/pubs/archive/37073.pdf> (Page 1).

32. The encoded portions of the video stream are included in the encoded video signal and the decoder decodes the encoded video signal to display the video stream. The decoding order of AV1 involves decoding the reference frames first and then switching to the encoded frames that are to be displayed.



<https://arxiv.org/pdf/1803.04061.pdf> (Page 1).

33. In view of preceding paragraphs, each and every element of at least claim 9 of the '960 Patent is found in the Accused Products.

34. ZTE has and continues to directly infringe at least one claim of the '960 Patent, literally or under the doctrine of equivalents, by making, using, selling, offering for sale, importing, and/or distributing the Accused Products in the United States, including within this judicial district, without the authority of Brazos.

35. ZTE has received notice and actual or constructive knowledge of the '960 Patent since at least the date of service of this Complaint.

36. Since at least the date of service of this Complaint, through its actions, ZTE has actively induced product makers, distributors, retailers, and/or end users of the Accused Products to infringe the '960 Patent throughout the United States, including within this judicial district, by, among other things, advertising and promoting the use of the Accused Products in various

websites, including providing and disseminating product descriptions, operating manuals, and other instructions on how to implement and configure the Accused Products. Examples of such advertising, promoting, and/or instructing include the documents at:

- <https://www.zteusa.com/axon-10-pro>.

37. Since at least the date of service of this Complaint, through its actions, ZTE has contributed to the infringement of the '960 Patent by having others sell, offer for sale, or use the Accused Products throughout the United States, including within this judicial district, with knowledge that the Accused Products infringe the '960 Patent. The Accused Products are especially made or adapted for infringing the '960 Patent and have no substantial non-infringing use. For example, in view of the preceding paragraphs, the Accused Products contain functionality which is material to at least one claim of the '960 Patent.

JURY DEMAND

Brazos hereby demands a jury on all issues so triable.

REQUEST FOR RELIEF

WHEREFORE, Brazos respectfully requests that the Court:

(A) Enter judgment that ZTE infringes one or more claims of the '960 Patent literally and/or under the doctrine of equivalents;

(B) Enter judgment that ZTE has induced infringement and continues to induce infringement of one or more claims of the '960 Patent;

(C) Enter judgment that ZTE has contributed to and continues to contribute to the infringement of one or more claims of the '960 Patent;

(D) Award Brazos damages, to be paid by ZTE in an amount adequate to compensate Brazos for such damages, together with pre-judgment and post-judgment interest for the

infringement by ZTE of the '960 Patent through the date such judgment is entered in accordance with 35 U.S.C. §284, and increase such award by up to three times the amount found or assessed in accordance with 35 U.S.C. §284;

(E) Declare this case exceptional pursuant to 35 U.S.C. §285; and

(F) Award Brazos its costs, disbursements, attorneys' fees, and such further and additional relief as is deemed appropriate by this Court.

Dated: March 26, 2020

Respectfully submitted,

/s/ James L. Etheridge

James L. Etheridge
Texas State Bar No. 24059147
Ryan S. Loveless
Texas State Bar No. 24036997
Travis L. Richins
Texas State Bar No. 24061296
ETHERIDGE LAW GROUP, PLLC
2600 E. Southlake Blvd., Suite 120 / 324
Southlake, Texas 76092
Telephone: (817) 470-7249
Facsimile: (817) 887-5950
Jim@EtheridgeLaw.com
Ryan@EtheridgeLaw.com
Travis@EtheridgeLaw.com

COUNSEL FOR PLAINTIFF